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THE 'WAR ON MICROBES'
INFECTIOUS DISEASES, BIO-WEAPONS, AND BIOLOGICAL SECURITY

By *David S. McDonough*
CISS Research Officer
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On 12 March, 2003 the World Health Organization (WHO) issued a global alert on severe acute respiratory syndrome (SARS). This previously unknown infectious disease originated in China. Soon it had spread to 28 countries in Asia, Europe, and North America, and infected a total of 8,098 people from November 2002 to July 2003. Of those infected, 774 were fatalities. The economic costs of the global outbreak were significant, with estimates ranging from US$10-billion to US$30-billion[1] before the disease was judged contained on 5 July, 2003.

The unexpected outbreak is indicative of an emerging threat to international security posed by new and existing infectious diseases. International attention is turning once again to Asia and the threat posed by Avian flu. At the same time, diseases like the human immunodeficiency virus and acquired immunodeficiency syndrome (HIV/AIDS) and tuberculosis (TB) have already ravaged whole continents. Canada is not isolated from this problem. It was the Western state most affected by SARS (with 43 confirmed fatalities) and is currently dealing with a persistent 'mad cow' problem in its cattle industry. Canada will continue to remain vulnerable to any international outbreak of Avian flu or re-emergence of SARS.

In international security discourse, there is still a tendency to reduce the threat of infectious diseases to one posed certain weapons of mass effect (WME) - specifically biological weapons (BW) in the hands of 'rogue states' or terrorist groups. Naturally-occurring infections are seen as a separate 'public safety' or 'public health' problem. But separating them into two distinct categories is no longer prudent. Doing so obfuscates the intimate relationship between bio-warfare/bio-terrorism (BW/BT) and naturally-occurring diseases, and neglects the important security ramifications of infectious diseases in general. The concept of 'biological security' offers a useful alternative paradigm that can bridge this divide, while recognizing the important differences between the two types of biological threats.

From WME to Biological Security

The WME security paradigm emerged from the changing US threat perception of the late 1980s and early 1990s, when nuclear weapons were still considered the foremost strategic threat. But chemical & biological weapons were gaining ground as more likely and, in the case of 'biologicals', potentially as deadly threats in and of themselves. This contrasts with the Cold War, when the US viewed biological arms as having "limited tactical utility" and not constituting "a reliable and effective strategic deterrent".[2]

Three events crystallized the biological threat. In 1994, the defection of Saddam Hussein's son-in-law, General Hussein Kamal, revealed that Iraq had developed a significant (and covert) BW capability. This was followed by the 1992 defection of Ken Alibek from Russia, who made a startling revelation: the Soviet Union had, despite official adherence to the Biological and Toxin Weapons Convention (BTWC), developed a covert BW program capable of industrial-scale production and the genetic-engineering of particularly lethal agents (ie. antibiotic-resistant, immunosuppressive, and/or genetically-combined strains).

The very real possibility of bio-terrorism was later demonstrated in the Aum Shinrikyo cult's experimentation with anthrax and botulism prior to its 1995 sarin attack on the Tokyo subway system.

Unfortunately, the inclusion of BW in the WME paradigm carries with it certain problems. Unlike other WME, the use of BW/BT would pose as much of a public health problem as a security problem. These weapons, while of limited value against military targets, are designed for 'countervalue' attacks against civilian populations. The threat posed by BW/BT, based on high virulence and possible contagiousness, is therefore dependent on an attack negatively affecting the public health of the target society.

Similarly, the detection and defence measures needed for any naturally-occurring disease will be comparable to and interoperable with the bio-defence measures required for BW/BT.[3] The 2001 anthrax scare in the US demonstrated the need for

robust public health measures such as the stockpiling of vaccines and antibiotics, and improvements to local and national surveillance and response capabilities. As noted by a US Department of Energy advisory group, the most feasible biodefence measure would be the medical surveillance of people, who represent 'mobile sensors' that can "self-report medically significant exposures to a broad range of pathogens."[4]

Lastly, naturally-occurring infectious diseases can have an effect comparable to many kinds of BW/BT attacks. Economic and food security can be threatened by a natural pathogen that targets certain agricultural products. Consequently, as many of a country's population can die from a natural outbreak as from an act of BW/BT.

The last 20 years have certainly demonstrated the grave dangers posed by naturally-occurring biological agents. On one hand, there is the emergence of new, previously unheard of pathogens. The HIV/AIDS pandemic, for example, has already infected more than 60 million and killed over 20 million.[5] This was followed by the discovery of numerous other diseases including, *inter alia*, Ebola hemorrhagic fever, Marburg fever, hantavirus, West Nile virus, Yellow fever, and, most recently, Avian influenza and SARS.

On the other hand, many previously mitigated diseases have re-emerged with new strains resistant to antibiotics. Perhaps the most distressing has been the emergence of multiple drug-resistant TB, which has had a deadly impact in Asia, Africa (where it often co-infects with AIDS), and even Russia . Sadly, this development is not limited to TB. The drug-resistance of malaria, HIV, and other diseases has been observed with greater frequency.

Naturally-occurring diseases are not a hypothetical threat; they exist and will likely present a growing danger for both the developed and the developing worlds. In southern Africa, for example, the security of entire countries is under threat due to the infection of a significant portion of the adult population. If HIV/AIDS or TB cut a swath through the professional classes – affecting healthcare workers, government officials, and entrepreneurs – the chances of social and economic collapse increase dramatically.

The threat posed by BW/BT demands a range of countermeasures. These may include non-proliferation regimes to prevent states from acquiring or desiring these weapons, or proactive counter-proliferation efforts and deterrence. But the relationship between natural and man-made biological dangers – a relationship characterized by similar socio-economic and political effects, as well as similar forms of public response – demands a new paradigm. The term 'biological security' should be adopted, as this holistic approach encompasses "the protection of people and agriculture against microbial threats, whether from biological weapons or natural outbreaks."[6]

Canada's Biological Security

Canada is not immune to biological security threats. While the impact of diseases will likely fall disproportionately on developing countries, all open societies will remain vulnerable to infectious outbreaks. The feasibility of closing our borders to prevent human- and animal-borne pathogens from coming into Canada is questionable. Even if a quarantine was implemented on a continental basis, it would negatively affect our economy and our relations with other countries.

Unfortunately, as infectious diseases continue to cause tremendous damage on the economic and human security of whole continents, the likely impact on Canada's economy will also be negative. Countries with high rates of infection and death will have difficulty importing Canadian goods or exporting their own. Even in cases with moderate rates of infection, the implementation of disease-containment measures will reduce the flow of goods and services.

Canada has not been completely oblivious to these threats. In 1993, Health Canada's Laboratory Centre for Disease Control organized an Expert Working Group on Emerging Infectious Disease Issues. The group called for a national strategy for surveillance and control of emerging and re-emerging infectious diseases, an improved public health infrastructure, a national vaccine strategy, and a centralized laboratory reporting system. Other relevant reports and commissions soon followed, the most recent being Health Canada's *Learning From SARS – Renewal of Public Health in Canada.*[7]

Although many past recommendations have not been implemented, there are some signs of improvement. Ottawa has established the Canada Public Health Agency, appointed a Chief Public Health Officer for Canada, and commenced a much-needed over-haul of the Canada Health Protection Act. In response to the growing international concern over the Avian flu, the government has unveiled its Canada Pandemic Influenza Plan, which emphasizes vaccine production and improvements in rapid-response capabilities.

More certainly needs to be done. As pointed out by Governor-General Adrienne Clarkson in the 2004 Speech from the Throne, "The shock of SARS demonstrated vividly our vulnerability to infectious diseases…Diseases such as SARS and the recent Avian flu pose threats which increased global mobility can only make worse."[8]

Clearly, not all threats to Canada's biological security are equal. A disease which taints our agricultural products might have a significant effect on the Canadian economy or even the health of those citizens who consume those products. But a combination of treatment and non-consumption of the infected products would mitigate the damage to human health. Far more catastrophic would be a hypothetical influenza pandemic, or the successful use of certain biological weapons such as anthrax, plague, or smallpox. To illustrate the different levels of threat, Canadian biological security will be examined as continuum, consisting of economic and food security, human security, and military security.

Economic and Food Security

Infectious diseases pose a clear and present danger to the economic and food security of Canadians. This was dramatically demonstrated on 20 May, 2003 when a case of *bovine spongiform encephalopathy* (BSE), better known as 'mad cow' disease, appeared in Canada. This neurological degenerative disorder affects the central nervous system of cattle.

As the world's third-largest beef exporter, the impact that this one case had on Canada's economic health was significant. A

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number of importers, including the United States and Japan, quickly banned beef and cattle imports from Canada. Reports indicate that the Canadian beef industry lost an estimated US $2.5-billion in the first six months of the ban.[9]

The incident also had an indirect impact on the US market, when Japan imposed restrictions on beef imports from the US, fearing that US cattle may have originated in Canada. Fortunately, changes in Canadian slaughterhouse practices and more restrictive import practices by the US mitigated the effect of this single BSE case.[10] Still, further cases of BSE in either Canada or the US would likely devastate the Canadian beef market. It would also have a knock-on effect on agricultural endeavours connected to this commodity (ie. cattle feed production).

Food security refers to a situation where people have access to sufficient and safe food for their dietary needs. Diseases like BSE can threaten food security in two ways. First, the consumption of BSE-infected beef opens the possibility of catching a variant of Creutzfeldt-Jakob Disease (CJD), a deadly degenerative disorder previously known to infect only seniors. While the likelihood of catching this disease is very small – consider the fact that the UK has only had roughly 100 cases of CJD – this possibility should not be discounted. Second, the mass slaughtering of cattle would reduce the availability of beef, forcing countries to increase reliance on foreign beef.

While BSE is perhaps the most likely economic and food security problem facing Canada in the near future, the possibility of other infectious pathogens should not be discounted. Foot-and-Mouth Disease (FMD) – which has recently appeared in parts of Asia and Europe – is highly communicable among hoofed animals, but is not a direct danger to people. While a less direct food security threat, FMD represents an even greater economic security threat than BSE.[11] The same could also be said of hog cholera, which is currently making an appearance in Northeast Asia. On the other hand, a disease like Avian flu poses a significant economic and food security threat and, due to the pathogen's ability to directly infect people, an even more significant human security threat.

The danger of Canada's economic and food security being threatened by microbes is real. Since agricultural commodities are traded on a global scale, it should come as no surprise that North America is not immune to this trend.

Human Security

Infectious diseases that are communicable among humans pose a more significant if less common threat to Canada's biological security. Canada has certainly experienced this kind of threat; the presence of HIV/AIDS and TB (both of which are becoming increasingly multiple-drug resistant) continues to be a public health problem. While the absolute number of such cases is small – 56,000 and 1,555 respectively[12] – there is the possibility that both diseases will re-emerge in the future. This is largely due to their increasing drug resistance and, perhaps more importantly for an immigrant-friendly nation, their accelerating levels in other countries.

Tropical pathogens like the malaria parasite and West Nile virus are also possible dangers. While both have their origins in tropical climates, changing environmental conditions and increased travel activity have created the preconditions for their introduction into North America. Given its high communicability, lethality, and growing drug resistance, the spread of malaria is especially worrisome.

New types of infectious diseases pose a growing threat to our security. Perhaps the most important example was SARS, which bore remarkable similarity to influenza, and gave health experts an opportunity to study the dynamics of a new outbreak. The etiology of the pathogen had to be identified, disease surveillance and monitoring had to be implemented, and attempts at containment and defence had to be coordinated on a local and global scale. In the end, Canadians suffered 251 infections, 43 fatalities, and a significant (if still unknown) degree of economic damage. This outbreak could have had a far more deadly effect if containment and quarantine measures had failed, or if a more virulent or contagious variant of the virus had emerged.

While SARS was effectively contained by July of 2003, the likelihood that new infectious outbreaks will emerge is increasing. It is for this reason that so much international attention has been drawn to the current bout of Avian influenza, which has so far spread to 8 countries and killed 22 people in Vietnam and Thailand out of 32 known infections.[13]

While relatively few people have died in the latest outbreak, there is a growing fear that this disease will eventually exchange genetic material with a human influenza virus. In a process known as 'antigenic shift', the swapping of genetic material between a human influenza virus and an Avian influenza virus could lead to the creation of a highly lethal strain – one that combines a high fatality ratio (of up to 30%) through airborne transmission.[14] Health Canada estimates that such a pandemic would hit Canada only three months after an initial outbreak. Between 4.5-10.6 million Canadians would fall clinically ill, resulting in up to 58,000 fatalities.[15]

The dangers posed by naturally-occurring infectious diseases to human security should be taken very seriously. These pathogens not only attack the human body, but also place tremendous pressure on an already burdened public health system. This weakens the economic security of a nation – especially if the disease targets healthy adults. Given the close relationship between human diseases and animal diseases, food security may also become a factor.

Of the diseases found in Canada, many, such as HIV/AIDS and TB, are under control. SARS has been contained. New strains of each are largely hypothetical at this time. This might be cause for complacency. But one should also recall the premature complacency of the 1960s and 1970s, when antibiotics and vaccinations seemed to herald an end to such biological threats. The devastating plague of HIV/AIDS emerged soon afterwards.

Military Security

The threat posed by BW/BT to the Canadian land mass is remote. Our closest experience to bio-terrorism was the anthrax attacks in the United States. But the threat that should not be discounted entirely. States continue to develop BW capabilities, and terrorists continue their search to develop or obtain BW agents. The nature of infectious diseases and our close

proximity to the United States – the most likely target of BW/BT – underscores the need for vigilance.

Depending on the particular agent and dispersal method, biological weapons can be used to target economic, food and human security. At the low end of the spectrum, anti-crop and anti-livestock BW could be used to wreck havoc on a target state's economy. Such an attack would have the added benefit of being easier to employ than human diseases; it could be produced by a series of limited infections triggered by pathogens delivered by simple methods.[16]

At the high end of the spectrum are attacks using pathogens that are deadly and infectious, such as anthrax, plague, smallpox, or botulism, which is not infectious but is highly lethal to those directly exposed. While an adequate dispersal method would have to be developed, a successful BW/BT attack by any of these diseases would be devastating.[17] If the virus was genetically-engineered – to make it immune to vaccines, antibiotic resistant, or more virulent – the target state's ability to contain such an outbreak would be significantly reduced.

If BW endanger the economic, food, and human security of Canadians, why place such threats under the rubric of 'military security'? The answer lies in the distinct military challenge posed by these weapons. To be sure, the counter-measures used for their detection, identification (to eliminate the possibility that it is a natural outbreak), and amelioration would be the same as those used against naturally-occurring infectious diseases. A robust public health system with 'surge capacity' (the ability to deal with an accelerating outbreak) would be key to such bio-defence efforts.

But while consequence management is one way of mitigating the effect of BW/BT, prevention or deterrence of an attack is a politico-military matter. A variety of measures – ranging from the promulgation of international non-proliferation conventions up to and including the use of force to disarm proliferators – could theoretically accomplish this. By contrast, such techniques cannot deal with outbreaks by natural pathogens.

Biological weapons represent the most significant biological security threat. They incorporate all the dangers of infectious diseases, and likewise necessitate detection and civilian biodefence measures. But since they can be engineered to resist vaccines and other conventional counter-measures, they must be dealt with through politico-diplomatic a well as technical means.

Conclusion

The threat to Canada's biological security is an unpleasant reality. Emerging and resurgent diseases could devastate our agriculture and threaten economic and food security. Given the volume of international trade and travel, an outbreak would adversely impact continental and international security.

An even more serious threat is posed by infections that imperil human security. The dramatic spread of SARS, and the drug-resistance of HIV/AIDS, TB, and malaria are indicative of this danger. One should also be cognizant of the dangers posed by a global influenza pandemic occurring in the near future.

In the current security environment, the possibility of a BW/BT attack on North American soil must be carefully considered. Prudent 'homeland defence' procedures and capabilities should be put in place to protect economic, food, and human security. On the international front, the establishment of biological databases and disease reporting mechanisms must continue, as should efforts to combat the spread of dangerous man-made biotechnologies. The development of a security strategy – one that accepts the security threat posed by naturally-occurring and non-naturally-occurring infectious diseases, that is cognizant of the relationship between them, and that prescribes effective counter-measures – should be a priority not only for Canada, but for all nations.

Notes:

[1]See World Health Organization factsheet, at http://www.who.int/csr/sars/country/table2003_09_23/en/ and Department of the Parliamentary Library, Australia, *Research Note*, No. 36 (May 2003).

[2]Jonathan B. Tucker, "Farewell to Germs: The U.S. Renunciation of Biological and Toxin Warfare, 1969-70," *International Security*, 27, 1 (Summer 2002), 127.

[3]Christopher F. Chyba, "Toward Biological Security," *Foreign Affairs* (May/June 2002), 122.

[4]JASON Group, *Biodetection Measures* (Washington D.C.: US Department of Energy, National Nuclear Security Administration, Febuary 2003), 4, at http://www.fas.org/irp/agency/dod/jason/biodet.pdf.

[5]Mark S. Solinski (Institute of Medicine), *Microbial Threats to Health: Emergence, Detection, and Response* (Washington DC: The National Academies Press, 2003).

[6]Chyba, "Toward Biological Security," 122.

[7]Other reports and commissions include: Mr. Justice Horace Krever's *Commission of Enquiry on the Blood System in Canada*, the Hon. Roy Romanow's *Commission on the Future of Health Care in Canada*, which emphasized the need for a national immunization strategy; and the Standing Senate Committee on Social Affairs, Science and Technology report, entitled *The Health of Canadians – The Federal Role*. For more on this issue, see *Learning From SARS – Renewal of Public Health in Canada* (Ottawa: Health Canada, 2003).

[8]Text of the Speech from the Throne can be found at http://pm.gc.ca/eng/sft-ddt.asp.

[9]Drew Desilver, "Mad-cow fallout begins: State beef industry could feel impact," *The Seattle Times* (December 29, 2003), at http://seattletimes.nwsource.com/html/madcowdisease/2001822405_madecon24m.html.

[10]Foreign Agricultural Service, US Department of Agriculture website, at http://www.fas.usda.gov/dlp/circular/2003/03-10LP/BSE.html.

[11]See Canadian Food Inspection Agency, *Food-and-Mouth Disease Contingency Measures: Strategy*, at http://www.inspection.gc.ca/english/anima/heasan/fad/fmd/fmd1-4e.shtml#1.

[12]This data comes from *Looking Forward: Focussing the Response*, Canada's Report on HIV/AIDS (Ottawa: Health Canada, 2003) and "Tuberculosis in Canada: 2002 pre-release," *Canada Communicable Disease Report*, 30, 1 (January 2003).

[13]World Health Organization website, at http://www.who.int/csr/disease/avian_influenza/country/cases_table_2004_02_19/en/. This data is recent as of 23 Febuary, 2004.

[14]Paul Taylor "'This could be way worse than SARS'," *The Globe and Mail* (January 17, 2004), F5.

[15]*Canada Pandemic Influenza Plan* (Ottawa, Health Canada, Population and Public Health Branch, 2004), Section One.

[16]Rocce Casagrande, "Biological Terrorism Targeted at Agriculture: The Threat to US National Security," *The NonProliferation Review*, (Fall/Winter 2000), 93.

[17]For example, the Dark Winter exercise (held 22-23 June, 2001) demonstrated that a smallpox outbreak in the US could spread to 16 countries in only 13 days, and would be exceedingly difficult to contain. More information can be found at: http://www.homelandsecurity.org/darkwinter/index.cfm.

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